* NOTICES *

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the terminal box which constitutes the output section of the suitable solar cell module for a solar energy power generation system.
[0002]
[Description of the Prior Art] As the solar energy power generation system which has spread in recent years consists of two or more solar cell modules by which array installation is carried out on roofs, such as a residence, and it is shown in drawing 17 The rear-face side output section 110 is minded for the solar cell module 100 of the number of appointed numbers, and --. Many one serials which come to connect each solar cell module which carries out a series connection mutually and is located in the start edge and the end of the series connection concerned with the entrance cables 140 and 140 prolonged to indoor, respectively are formed successively. The system which links with a commercial power system through an indoor inverter, and is supplied to indoor electric wiring is common.
[0003] As a solar cell module 100, as shown in drawing 18 two output cables 106 and 106 which extend from the susceptor 130 which supports a solar battery 120 and this solar battery, the terminal box 101 which constitutes the output section 110 prepared in the rear-face side of a solar battery 120, and this terminal box and with which polarities differ mutually -- a sake -- ** -- it is -- It connects with the output section or the above-mentioned entrance cable 140 of other adjoining modules by making each output cable 106 extend to an eaves and ridge side through insertion slot 130a of said susceptor 130, and the insertion slot of a ridge side module which is not illustrated, respectively.
[0004] The terminal box 101 which constitutes the output section of these solar cell modules has the internal structure shown in drawing 19 as indicated by JP,11-026035,A.
[0005] That is, two junction terminals 104 and 104 are arranged by bilateral symmetry to the case 105 box-like interior equipped with insertion opening 105a for inserting in the electrode material for output fetch which protruded on the rear-face side of the solar battery concerned in the predetermined part of the bottom wall 152 which contacts a solar-battery rear-face side, and the above-mentioned output cable 106 which extends to the case exterior is connected to the end face side of each junction terminal 104. A by-pass diode 102 is connected among each junction terminals 104 and 104, and the bypass circuit prevented beforehand is constituted [that a reverse current flows into this module in the time of a part of two or more cels which constitute a solar battery being shadows, the night, etc., and].
[0006]
[Problem(s) to be Solved by the Invention] By the way, the junction terminal 104 and the by-pass diode 102 connected among 104 The general-purpose diode packaging was carried out [diode] by the resin seal is used from the former. The concrete topology with the junction terminal 104 Although carried out through the conductive thin line which carried out wirebonding to the electrode layer of diode within this packaging, and the lead wire 121 which is connected [this] and is directly soldered to the junction terminal 104 In the rear-face side of the solar cell module installed on roofs, such as a residence The temperature gradient by change of day and night, a season, etc. is [about]. -Since it becomes the hot environments which are as large as 40 degrees C - 90 degrees C, and exceed 80 degrees C in the day ranges of summer, in the by-pass diode of the above topologies Cannot make the heat generated to this diode fully radiate heat through a thin line and lead wire, especially it sets under hot environments. The property of the diode expected was not secured but it also had the problem that diode was disconnected or destroyed by that a required bypass function is not demonstrated and the heat energy which rose.
[0007] It is accomplished in view of the starting present condition, the heat dissipation nature of a by-pass diode is

maintained, and this invention uses as an offer plug the terminal box where a predetermined diode capacity is unsecured in the bottom of hot environments.

[0008]

[Means for Solving the Problem] this invention person is ****(ing) the by-pass diode of a thin bare chip between each conductive metallic thin plate, as a result of advancing examination wholeheartedly in solving the above-mentioned technical problem. The cross section and said touch area of that the heat which touch area sufficient between bare chips and conductive metallic thin plates concerned was maintained, and was produced in the bare chip radiates heat promptly through a conductive metallic thin plate, and said conductive metallic thin plate by setting up suitably Energization of the predetermined amount of need currents is attained to a bare chip under hot environments, such as summer, and it came to complete a header and this invention for a bypass function being certainly maintainable.

[0009] This invention namely, inside a case with insertion opening in which the electrode material for output fetch of a solar battery is inserted Single ** connected between two or more junction terminals with which said electrode material was equipped with the connection connected electrically, and these junction terminal is a terminal box which constitutes the output section of the solar cell module which arranged two or more by-pass diodes. The polymerization section of the conductive metallic thin plate of the two-sheet lot which fixes for a junction terminal, respectively, and counters mutually, and extends between said junction terminals is equipped with the bypass circuitry object which comes to **** said thin bare chip, using a thin bare chip as said by-pass diode. In case the predetermined amount of need currents energizes in the bypass circuit concerned, at least Following (A) - (C):(A) daylight, Each temperature-change element of the heat dissipation temperature reduction of a bare chip based on heat conduction through each conductive metallic thin plate joined to the self-(temperature rise C) vertical electrode layer of the bare chip based on generation of heat by the change (B) energization of a bare chip ambient temperature based on the effect of tile temperature etc. The terminal box which comes to set up the cross-sectional area in each conductive metallic thin plate and the plane-of-composition product to said electrode layer, respectively is offered so that the skin temperature of the comprehensive bare chip may become below thermal runaway temperature.

[0010] Since such a terminal box is the configuration which fastened the by-pass diode of a thin bare chip to the polymerization section of the conductive metallic thin plate which extends between junction terminals, the heat generated in said bare chip While radiating heat promptly by heat conduction through the conductive metallic thin plate joined to the vertical electrode layer The above (A) Since the cross section and the plane-of-composition product of a conductive metallic thin plate are set up based on each temperature-change element of - (C), In spite of the rapid temperature change of a terminal box installation environment, the outstanding heat dissipation nature through said conductive metallic thin plate is maintained, and the bypass function of the bare chip which energizes the amount of need currents in a bypass circuit is maintained certainly.

[0011] Here, skin temperature change of the bare chip at the time of the bypass circuit energization synthesizing a temperature-change element (B) and a temperature-change element (C) amount [of currents] 1A Hits, and sufficient bypass function is maintained under hot environments, such as summer, with the terminal box which is a temperature rise 17 degrees C or less.

[0012] Moreover, it is more effective, if the silicon resin which was excellent in thermal conductivity especially as potting material by being the terminal box where potting material is poured into the interior of a case, and the heat dissipation temperature reduction of the bare chip of a temperature-change element (C) becoming large since the heat dissipation operation which led this potting material is added to a temperature-change element (C) with the terminal box which comes to take into consideration heat conduction by said potting material is used after arranging a by-pass diode.

[0013] Furthermore, if the copper plate with large thermal conductivity as said conductive metallic thin plate is used, the heat dissipation temperature reduction of the bare chip through the conductive metallic thin plate concerned which is a temperature-change element (C) will become large.

[0014]

[Embodiment of the Invention] Next, the operation gestalt of this invention is explained to a detail based on an accompanying drawing. Drawing 1 shows the whole solar cell module output section 10 configuration in this invention, drawing 1 -14 show the typical operation gestalt of the terminal box concerning this invention, in the sign 1 in drawing, a terminal box and 2 show 3a and a bare chip and 3b show the conductive metallic thin plate, respectively.

[0015] As the terminal box 1 concerning this invention is shown in drawing 1 and drawing 2 , the electrode material

for output fetch of a solar battery, For example, inside the case 5 which has insertion opening 5a by which two lead wire connected, respectively is inserted in the plus electrode and minus electrode of a solar battery In two or more junction terminals 4 and 4 and the list which said electrode material equipped with the connection 41 electrically connected by junction means, such as soldering It is the terminal box 1 which constitutes these junction terminal 4 and the output section 10 of the solar cell module which arranged the by-pass diode connected among four. Conductive metallic-thin-plate 3a of the two-sheet lot which fixes for the junction terminal 4, respectively, and counters mutually, and extends between the junction terminal 4 and 4, using the thin bare chip 2 as a by-pass diode, By equipping the polymerization section 31 of 3b with the bypass circuitry object 7 which comes to **** said bare chip 2 Conductive metallic-thin-plate 3a in which the heat generated in the bare chip 2 has a wide range touch area to this bare chip, Radiate heat promptly by heat conduction which led 3b and junction terminal 4 grade, and further the cross section S1 of each conductive metallic thin plates 3a and 3b shown in the simplified schematic of drawing 3 , and the plane-of-composition product S2 to said electrode layer by setting up, as shown below In spite of the rapid temperature change of a terminal box installation environment, it is the terminal box where the outstanding heat dissipation nature through said conductive metallic thin plates 3a and 3b was maintained, and the bypass function of the bare chip 2 which energizes the amount of need currents in a bypass circuit was maintained certainly.

[0016] Namely, the cross section S1 and the plane-of-composition product S2 of conductive metallic-thin-plate 3a (3b) in this invention When the predetermined amount of need currents energizes in the bypass circuit formed with the bypass circuitry object 7 At least Following (A) - (C):(A) daylight, The skin temperature of the bare chip 2 synthesizing each temperature-change element of the heat dissipation temperature reduction of a bare chip based on heat conduction through each conductive metallic thin plate joined to the self-(temperature rise C) vertical electrode layer of the bare chip based on generation of heat by the change (B) energization of a bare chip ambient temperature based on the effect of tile temperature etc. It is set up so that it may become below the thermal runaway temperature of the bare chip 2 concerned.
[0017] The solar cell module is working, and the bare chip ambient temperature of a temperature-change element (A) is bare chip skin temperature in case a bypass circuit is in the condition of not energizing, and receives effect in the operating temperature of atmospheric temperature, and the raw material property of each part of a terminal box containing a case, structure and a solar cell module etc. in addition to the effect of the above-mentioned daylight and tile temperature.
[0018] The self-temperature rise of a temperature-change element (B) is based on the heat generation characteristic of each bare chip suitably chosen according to the capacity of a solar cell module etc.
[0019] The heat dissipation temperature reduction of a temperature-change element (C) is specified by the thermal conductivity of the conductive metallic thin plates 3a and 3b, the specific heat, the cross section S1, the plane-of-composition product S2, die-length L, etc. based on heat conduction through each conductive metallic thin plates 3a and 3b joined to the vertical electrode layer of a bare chip 2.
[0020] And skin temperature change of the bare chip 2 at the time of the bypass circuit energization synthesizing a temperature-change element (B) and a temperature-change element (C) The calorific value of the bare chip 2 concerned, said conductive metallic-thin-plate 3a, the thermal conductivity of 3b and other members, The analytical approach based on the differential equation of heat conduction [****] using the specific heat etc., and a finite difference method, It is possible to predict by numerical solutions, such as the finite element method, and other solution methods. amount [of currents] 1A This skin temperature change by setting up the above-mentioned cross section S1 which hits and serves as a temperature rise 17 degrees C or less, and the plane-of-composition product S2 The terminal box which maintains sufficient bypass function under hot environments, such as summer, is constituted.
[0021] The configuration of each part is explained in more detail below.
[0022] The junction terminal 4 consists of long picture shape [of a plane view abbreviation rectangle] metal plate manufacturing-like members. After connecting the output cable 6 by forming the connection 41 where **** solder is installed by head side 43 which attends insertion opening 5a of a case pars basilaris ossis occipitalis on the top face, and carrying out the caulking stop of the core wire to end face side 44 of another side, as shown in drawing 4 By equipping the anchoring projection 93 with the sticking-by-pressure ring 14, after inserting in the corresponding anchoring holes 45 and 46 the anchoring projection 93 and locating lug 94 which protruded on the upper part from the case bottom wall 52, respectively While stopping the junction terminal 4 concerned to a bottom wall 52, the output cables 6 and 6 After ****(ing) between the fixed pedestal 56 which protrudes along the extension direction

of the output cable concerned from the case pars basilaris ossis occipitalis, and the holddown member 57 which fits into this from the upper part, It is arranged in the case 5 interior with said junction terminal 4 by fixing mutually the envelope of said fixed pedestal 56, a holddown member 57, and the output cables 6 and 6 to a case 5 and one by ultrasonic welding.

[0023] In addition, the connecting means of the junction terminal 4 and the output cable 6 A means it to be also desirable for to perform spot welding further from after [said] carrying out a caulking stop or to carry out the screw stop of the output cable to a junction terminal, and to arrange the junction terminal 4 on the case 5 interior A means it to be desirable to fuse anchoring projection 93 head ultrasonically etc. and to major-diameter-ize it instead of or to also carry out [said sticking-by-pressure ring 14] a screw stop, and to fix the output cable 6 to a case 5 It is also desirable to carry out the screw stop of the fixed pedestal 56 and holddown member 57 which ****(ed) this cable, or to fix to a direct case by the clamp.

[0024] The water proof connectors 61 and 62 which carried out the inner package of a plug or the socket are formed at the head of the output cables 6 and 6, and connection of these output cables 6 and 6 is carried out to the output cable or entrance cable of a solar cell module which adjoins through said water proof connector.

[0025] The by-pass diode of the thin bare chip 2 forms a P type layer in the front face of for example, an N type silicon wafer by diffusion process, etching formation of the grid-like concave is carried out on a front face, and after giving glass passivation to the PN-junction section currently appeared to this concave, while forming an electrode layer in the diode component and wafer rear face which were partitioned off with this concave, the mesa diode chip obtained by separating into plurality along with this concave is used. The junction temperature in the PN-junction section of this thin bare chip is about 150 degrees C, and this junction temperature turns into thermal runaway temperature of the bare chip 2 concerned. Therefore, production of the bypass circuitry object 7 is faced. The cross-sectional area of each conductive metallic thin plates 3a and 3b, and the plane-of-composition product to the electrode layer of the bare chip upper and lower sides It sets up so that the skin temperature of the bare chip synthesizing each above-mentioned temperature-change element (A) - (C) may become 150 degrees C or less. With this operation gestalt As shown in drawing 5 , it migrates to a perimeter all over the abbreviation for vertical each electrode layer of the thin bare chip 2 which covered the glass passivation layer. The with a thickness of about 0.2mm it is thin from oxygen free copper end side of each conductive metallic thin plates 3a and 3b is joined, respectively, and the bypass circuitry object 7 which consists of the conductive metallic thin plates 3a and 3b and the thin bare chip 2 of a two-sheet lot is promptly and certainly constituted out of a case. In addition, the simple substance or alloy of the aluminum which was excellent in thermal conductivity in addition to copper, and gold and silver can use suitably each conductive metallic thin plates 3a and 3b.

[0026] The anode electrode side of the configuration of each electrode layer is the abbreviation square whose 2.45x2.45mm and cathode electrode side is 2.7x2.7mm. The width of face in the polymerization section of each conductive metallic thin plate joined to these electrode layer Sheet metal 3b by the side of 2.3mm and a cathode electrode by 4.0mm [sheet metal 3a by the side of an anode electrode] Through the junction gold 8 which curses a cream pewter etc., the whole abbreviation surface of an electrode layer is held, respectively, and the plane-of-composition product by the side of 2 and a cathode electrode is set as 2 for the plane-of-composition product S2 by the side of an anode electrode about 17.3mm about 5.6mm, respectively.

[0027] Thus, the bypass circuitry object 7 which consists of conductive metallic thin plates 3a and 3b and a by-pass diode of the thin bare chip 2 fastened to the polymerization section 31 has done so the effectiveness that a light-gage next door and a case are more miniaturizable compared with the part by which a resin seal is not carried out, and the conventional by-pass diode in addition to the heat dissipation nature which was excellent in the ****. However, this invention is not being limited to such structure and carrying out packaging of the perimeter of the polymerization section 31 by the resin seal, and it is also desirable to prevent beforehand that the body of a soldering iron, a tool, and others does per direct, a heat damage, and breakage to the by-pass diode of the thin bare chip 2 like [raise further the workability and heat dissipation nature at the time of attachment of the bypass circuitry object concerned, and] the below-mentioned protection rib.

[0028] In case the above-mentioned junction terminals 4 and 4 are arranged, the anchoring hole 46 in which a locating lug 94 is inserted It is punctured by end face side 44 approach to the longitudinal direction center section of one of the junction terminals 4. In case the bypass circuitry object 7 is already attached in these junction terminal 4 and the case 5 with which the output cable 6 was arranged in 4 lists As shown in drawing 6 , the locating lug 94 which penetrated said anchoring hole 46 and projected to the junction terminal 4 upper part by engaging with the tooling holes 34 drilled in one conductive metallic-thin-plate 3b It is joined by each end face approach of the

junction terminals 4 and 4 by it being mediated easily and promptly in the condition of having been positioned between the top faces of the junction terminals 4 and 4, and fixing each conductive metallic thin plates 3a and 3b with soldering on the top face of the junction terminal 4, without mistaking the mediation direction of the bypass circuitry object 7 concerned.

[0029] In the side edge section of the conductive metallic thin plates 3a and 3b in the bypass circuitry object 7 Two or more pairs of ribs 9 and -- which stand up up are attached along with the side edge section concerned rather than the conductive metallic thin plate 3 concerned from the bottom wall 52 of a case 5. In detail As shown in drawing 2 , the protection rib 92 of the couple attached to one end 71a of each conductive metallic thin plates 3a and 3b, two pairs of regulation ribs 91a and 91b attached along with 71b edges on both sides, and a list along with polymerization section 31 edges on both sides to which the bare chip 2 is fastened is attached, respectively.

[0030] In case the regulation ribs 91a and 91b mediate between the bypass circuitry object 7 between the top faces of the junction terminals 4 and 4, they are putting one end 71a and 71b of the conductive metallic thin plate 3 between the ribs concerned, respectively here. It is what functions as a positioning means of this conductive metallic thin plate 3, and does the attachment activity of the bypass circuitry object 7 concerned easily and quick. In more detail The narrow section 35 which extends on the outside of the junction terminal 4 is beforehand formed in one end 71a which does not constitute the polymerization section in one conductive metallic thin plate, and it can attach and do by putting this narrow section 35 between regulation rib 91a corresponding to this, without mistaking the direction of pons delivery.

[0031] Moreover, in case the protection rib 92 similarly mediates between the bypass circuitry object 7 between the top faces of the junction terminals 4 and 4, it is putting the polymerization section 31 between the ribs concerned. Heating means, such as a soldering iron used for junction for the bypass circuitry object 7 and the junction terminal 4 between which it mediated, or junction for the below-mentioned electrode material for output fetch and the junction terminal 4, contact the polymerization section 31 directly, In case the box body 11 which incorporated the bypass circuitry object 7 concerned in the case is transported, the body of a tool and others avoids giving a direct impact to the polymerization section 31 etc., and prevents beforehand breakage by the heat damage and impact of a by-pass diode.

[0032] In addition, although other ribs may be prepared in a case in addition to regulation riba [91] and 91b and protection rib 92, it is desirable [these ribs] to prepare in parallel to the extension direction 91a and 91b, i.e., the regulation ribs, or the protection rib 92 of the conductive metallic thin plates 3a and 3b so that it may fill up with potting material smoothly without a clearance between the member of said bypass circuitry object and others, and a case bottom wall etc.

[0033] When it is suitably determined according to the capacity of a solar cell module etc., for example, parallel connection of the two by-pass diodes is carried out between the junction terminal 4 and 4, as shown in drawing 7 , the number of the by-pass diode formed in the interior of a case 5 adjoins two, and should just mediate between it and join to parallel the bypass circuitry object 7 described above between the top faces of the junction terminals 4 and 4 concerned. Thus, if parallel connection of two or more bypass circuitry objects 7 is carried out, the amount of currents at the time of energization will be distributed, and it will become possible to suppress the self-temperature rise by generation of heat of each bare chip of the temperature-change element (B) mentioned above.

[0034] Moreover, although each conductive metallic thin plates 3a and 3b which constitute the bypass circuitry object 7 are flat plates and have the approximate straight configuration in the longitudinal direction Since big shearing force may arise in the by-pass diode of the thin bare chip 2 which said conductive metallic thin plate repeated telescopic motion by the thermal expansion resulting from temperature changes, such as day and night, and was fastened to the polymerization section 31, When the clearance between the junction terminal 4 and 4 is large and the extension dimension of each conductive metallic thin plate 3 becomes large especially What established the curved part 32 or the crooked part 33 in the whole or the part which met in the extension direction of these conductive metallic thin plates 3a and 3b is desirable so that it may illustrate to (a) of drawing 8 , and (b).

[0035] The terminal box 1 concerning this operation gestalt is equipped with the lid 51 fitted in the upper bed opening 53 of a case 5. Like the above, the bypass circuitry object 7 between the top faces of the junction terminals 4 and 4 pons delivery and the box body 11 which it comes to join Where the electrode material for output fetch is inserted in the interior of a case through insertion opening 5a After being fixed to a solar-battery rear-face side by the screw, adhesives, a binder, etc. and connecting said electrode material to the connection 41 of the junction terminal 4, as shown in drawing 9 To the predetermined space 55 in these electrode material 12, the bypass circuitry object 7, and the case that the junction terminals 4 and 4 were installed inside, and was surrounded by the septum 54

shown in the by-pass diode FSF ten A60 for 10A and 20A, and drawing 19 using FSKF20A (all are the Nihon Inter Electronics Corp. make), respectively.

[0044] In each terminal box of an example 1 and an example 2, drawing 15 is a graph which shows the relation between the amount of currents energized to a bare chip, and the lifting temperature then surveyed on the surface of a bare chip, and is based on the actual measurement of the bare chip skin temperature change synthesizing an above-mentioned temperature-change element (B) and (C). Drawing 16 is a graph which shows relation with the amount of currents which can be energized with ambient temperature and this ambient temperature in each terminal box of the above-mentioned example 1, an example 2, the example 1 of a comparison, and the example 2 of a comparison.

[0045] The temperature rise of 11 degrees C of amount of currents 1A per abbreviation and the terminal box 1 of an example 2 are the temperature rises of 14 degrees C of amount of currents 1A per abbreviation, and the terminal box 1 of the example 1 concerning this invention all fulfills the lifting temperature of 17 degrees C or less so that the graph of drawing 15 may show. Moreover, it turns out that the temperature rise is controlled compared with the example 2 which the example 1 which enclosed silicon resin with the interior of a terminal box has not enclosed, and heat dissipation of a bare chip is promoted by enclosure of silicon resin.

[0046] And according to the graph of drawing 16 , it sets at the summer when ambient temperature becomes 80-90 degrees C or more. The amount of currents which flows to the by-pass diode of the example 1 of a comparison Below abbreviation 1.07A As opposed to the amount of currents which flows to the by-pass diode of the example 2 of a comparison becoming below abbreviation 1.37A, and sufficient bypass function not being maintained in the bare chip of an example 1 It turns out that an ambient temperature is secured at about 107 degrees C, amount of currents 4A is secured with the ambient temperature of 94 degrees C in the bare chip of amount of currents 4A, and an example 2, and sufficient bypass function is demonstrated under the hot environments used as the ambient temperature of 90 degrees C or more.

[0047]

[Effect of the Invention] Since it is the configuration which fastened the by-pass diode of a thin bare chip to the polymerization section of the conductive metallic thin plate which extends between junction terminals according to the terminal box according to claim 1 While the heat generated in said bare chip radiates heat promptly by heat conduction through the conductive metallic thin plate joined to the vertical electrode layer Since the cross-sectional area and plane-of-composition product of a conductive metallic thin plate are set up so that a bypass circuit may always function in case the predetermined amount of need currents energizes in the bypass circuit concerned, the bypass function of a bare chip is certainly maintained in spite of the rapid temperature change of a terminal box installation environment.

[0048] Since according to the terminal box according to claim 2 skin temperature change of the thin bare chip at the time of bypass circuit energization amount [of currents] 1A Hits and is a temperature rise 17 degrees C or less, bypass function sufficient also in the bottom of hot environments, such as summer, is maintained.

[0049] Since according to the terminal box according to claim 3 the heat dissipation operation which led potting material is added and the heat dissipation temperature reduction of a bare chip becomes large, it also becomes possible to attain miniaturization of the whole terminal box by making smaller the cross-sectional area of a conductive metallic thin plate, for example.

[0050] Since the silicon resin which was excellent in thermal conductivity as said potting material is used according to the terminal box according to claim 4, the heat dissipation temperature reduction of said bare chip becomes larger.

[0051] According to the terminal box according to claim 5, since the copper plate with the large heat conductivity as said conductive metallic thin plate is used, the heat dissipation temperature reduction of the bare chip through the conductive metallic thin plate concerned becomes large, and becomes possible [attaining miniaturization of the whole terminal box similarly].

[Translation done.]

By being poured in and filled up with the potting material 13 which consists of an epoxy resin, polyurethane, silicon resin, etc., after closing airtightly a part for each part material and the connection, the upper bed opening 53 is blockaded with said lid 51, and the assembly of the terminal box 1 is completed.

[0036] Said potting material 13 is closing airtightly a part for each part material allotted to the interior of a case 5, and a connection. If what maintains insulation and was excellent in thermal conductivity especially as said potting material is adopted preventing encroachment of moisture, storm sewage, dust, etc., etc. and preventing the corrosion and degradation, and breakage by the impact The heat dissipation nature of a bare chip 2 can be raised more through the potting material concerned with which the polymerization section 31 is filled up up and down.

[0037] And it sets in such a terminal box 1. Conductive metallic-thin-plate 3a in which the heat which generated heat with the bare chip 2 is carrying out heat contact at the vertical electrode layer of a bare chip 2 as shown in drawing 10 , To 3b and each sheet metal 3a (3b) at the junction terminal 4 which is carrying out heat contact, the potting material 13, and this by assuming the heat flow rate way which used as the heat transfer member the output cable which is carrying out heat contact, and the case 5 The bare chip skin temperature at the time of the bypass circuit energization which comes to synthesize the temperature-change element (B) mentioned above and a temperature-change element (C) can be predicted.

[0038] In addition, as the above-mentioned potting material 13 is not necessarily required and it is shown in drawing 11 in this case Conductive metallic-thin-plate 3a in which the heat which generated heat with the bare chip 2 is carrying out heat contact at the vertical electrode layer of a bare chip 2, Similarly bare chip skin temperature can be predicted at 3b and each sheet metal 3a (3b) by assuming the heat flow rate way which used as the heat transfer member the output cable which is carrying out heat contact, and the case 5 for the junction terminal 4 and each junction terminal 4 which are carrying out heat contact.

[0039] Moreover, although the bypass circuitry object 7 which consists of a by-pass diode of the thin bare chip 2 fastened to the conductive metallic thin plates 3 and 3 and the polymerization section 31 of those of the two-sheet lot which extended between junction terminals is formed in the condition of having floated more nearly up than the case bottom wall 52 As it is not limited to the structure which prepared space caudad in this way and is shown in drawing 12 , as for this invention, what is made to stick the underside of the polymerization section 31 which is fastening the thin bare chip 2 to the case bottom wall 52, and aims at improvement in heat dissipation nature through this bottom wall 52 is desirable. In this case, the heat flow rate way from conductive metallic-thin-plate 3a to the case bottom wall 52 is added, and the heat dissipation effectiveness of a bare chip improves.

[0040] As other examples of a terminal box, as shown in drawing 13 and drawing 14 The connection 41 which connects the electrode material 12 for output fetch to said junction terminal 4, the fixing section which fixes the conductive metallic thin plate 3, and the junction terminal 4 whole concerned except the near section, The output cable 6 which is connected to the end face side of this junction terminal 4, and extends to the case 5 exterior a case -- five -- one ---like -- fabricating -- becoming -- a terminal -- a box -- one -- ' -- desirable -- a case -- a bottom wall -- 53 -- **** -- potting -- material -- restoration -- airtight -- it should close -- a connection -- 41 -- and -- fixing -- the section -- surrounding -- a septum -- 54 -- ' -- setting up -- having -- **** .

[0041] Such a box body 11 of terminal box 1' In case a case 5 is fabricated, the output cable 6 already connected to this junction terminal 4 and end face side is inserted in metal mold. Carry out injection molding to the case 5 concerned in one, it is produced, and the anchoring projection 93 for fixing the required junction terminal 4 and the output cable 6 to a case in the above-mentioned terminal box 1, the anchoring hole 45, the sticking-by-pressure ring 14, and holddown-member 57 grade become unnecessary. While there are few components mark and being simplified like an erector, a manufacturing cost is reduced substantially. Moreover, compared with the space 55 where the space surrounded by septum 54' is surrounded by the septum 54 of the above-mentioned terminal box 1, only the part which does not contain a part for a connection with the output cable 6 in junction terminal end face side 44 becomes small, and the amount of the potting material used with which it is filled up is also reduced.

[0042]

[Example] Next, the terminal box concerning this invention is compared with the conventional terminal box.

[0043] As an example 1 is shown in the above-mentioned typical operation gestalt, all over the abbreviation for the vertical electrode layer of mesa mold bare chip PTD27K (powered limited company make) With a thickness of 0.2mm copper plate 3a, The terminal box 1 and example 2 which were equipped with the bypass circuitry object 7 which joined 3b, respectively, and enclosed silicon resin with the interior as potting material The terminal box 1 and the example 1 of a comparison which are similarly equipped with the bypass circuitry object 7, and do not enclose potting material with the interior, and the example 2 of a comparison It is the terminal box 101 from the former

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2001-168368
(43)Date of publication of application : 22.06.2001

(51)Int.Cl. H01L 31/042
H01R 9/22
H02G 3/16
H02G 15/16

(21)Application number : 11-349774
(22)Date of filing : 09.12.1999

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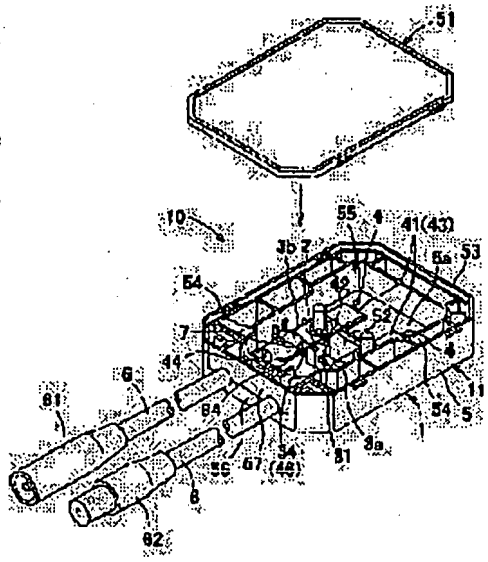
(54) TERMINAL BOX

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a terminal box which can maintain the heat radiating property of a bypass diode while securing a specified diode capacity under a high temperature environment.
SOLUTION: A thin bare chip 2 is used as a bypass diode. The bare chip 2 is held between overlapping parts 31 of a set of two conductive metal thin plates fastened to respective relay terminals and extended between these relay terminals in such a manner as to face each other, to form a bypass circuit structure 7. When supplying a specified necessary amount of current to the bypass circuit, a cross-sectional area of each conductive metal thin plate and a joint area of each conductive metal thin plate with a corresponding electrode layer are so set that the surface temperature of the bare chip with the following changes in temperature considered may be the thermal destruction temperature or below: the temperature change elements include at least (A) a change of the ambient temperature of the bare chip based on the influence by the sun beam, the temperatures of roof tiles or the like, (B) the increase in temperature of the bare chip itself based on the generation of heat by conduction, and (C) the decrease in heat radiation temperature of the bare chip based on the thermal conduction through the conductive metal thin plates joined to the upper and lower electrode layers.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

(19)日本国特許庁（JP）　(12)公開特許公報（A）　(11)特許出願公開番号
特開2001－168368
(P2001－168368A)
(43)公開日　平成13年6月22日(2001.6.22)

(51)Int.Cl.'	識別記号	F I		テーマコード'(参考)
H01L 31/042		H01R 9/22		5E086
H01R 9/22		H02G 3/16	Z	5F051
H02G 3/16		15/16		5G361
15/16		H01L 31/04	R	5G375

審査請求　未請求　請求項の数5　OL　（全 11 頁）

(21)出願番号　特願平11－348774

(22)出願日　平成11年12月9日(1999.12.9)

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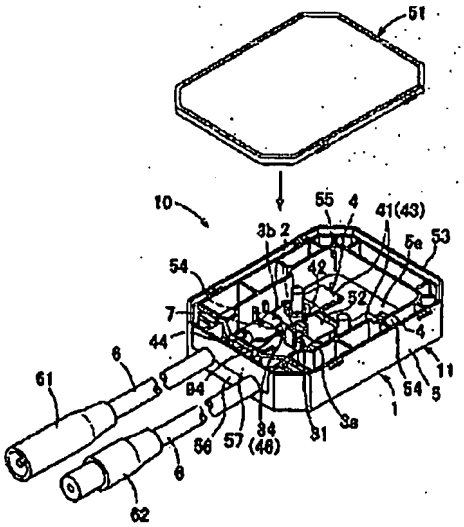
Fターム(参考)　5E086 CC12 CC46 CC50 DD09 DD33
DD49 JJ28 LL04 LL17 LL20
5F051 BA03 BA18 BA17 JA07 JA08
5G361 BA07 BB01 BC01 BC03
5G375 AA02 BA26 BB18 CA02 CA12
CA17 CB03 CB10 CC07 CC10
DA36 DB26 DB44

(54)【発明の名称】　格子ボックス

(57)【要約】
【課題】　バイパスダイオードの放熱性が維持され，高温環境下においても所定のダイオード容量が確保される格子ボックスを提供せんとする。
【解決手段】　バイパスダイオードとして薄型ベアチップ2を用い、それぞれ中継端子に固着され且つ互いに対向して中継端子間に延出する二枚一組の導電性金属薄板の重合部31に前記薄型ベアチップを挟装してなるバイパス回路構成体7を備え，当該バイパス回路に所定の必要電流量が通電する際，少なくとも（A）日光，環境温度等の影響に基づくベアチップ周囲温度の変化，（B）通電による発熱に基づくベアチップの自己温度上昇，（C）上下電極層に接合している各導電性金属層薄板を介した熱伝導に基づくベアチップの放熱温度降下，の各温度変化要素を総合したベアチップの表面温度が熱破壊温度以下となるように，各導電性金属層薄板における断面積及び電極層に対する接合面積をそれぞれ設定してなる。



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【特許請求の範囲】

【請求項１】 太陽電池の出力取出用電極材が挿通される挿通口を有した筐体の内部に、前記電極材が電気的に接続される接続部を備えた複数の中継端子、及びこれら中継端子間に接続される単又は複数のバイパスダイオードを配設した太陽電池モジュールの出力部を構成する端子ボックスであって、前記バイパスダイオードとして薄型ベアチップを用い、それぞれ中継端子に固着され且つ互いに対向して前記中継端子間に延出する二枚一組の導電性金属薄板の重合部に前記ベアチップを挟装してなるバイパス回路構成体を備え、当該バイパス回路に所定の必要電流量が通電する際、少なくとも下記（Ａ）～（Ｃ）：

（Ａ）日光、瓦温度等の影響に基づくベアチップ周囲温度の変化

（Ｂ）通電による発熱に基づくベアチップの自己温度上昇

（Ｃ）上下両面に接合している各導電性金属薄板を介した熱伝導に基づくベアチップの放熱温度降下

の各温度変化要素を総合したベアチップの表面温度が熱破壊温度以下となるように、各導電性金属薄板における断面積及び前記電極面に対する接合面積をそれぞれ設定してなる端子ボックス。

【請求項２】 温度変化要素（Ｂ）と温度変化要素（Ｃ）を総合したバイパス回路通電時のベアチップの表面温度変化が、電流量１Ａ当たり１７℃以下の温度上昇である請求項１記載の端子ボックス。

【請求項３】 バイパスダイオードを配設した後、筐体内部にポッティング材が注入される端子ボックスであって、温度変化要素（Ｃ）に前記ポッティング材による熱伝導を考慮してなる請求項１又は２記載の端子ボックス。

【請求項４】 前記ポッティング材としてシリコン樹脂を用いた請求項３記載の端子ボックス。

【請求項５】 前記導電性金属薄板が銅板である請求項１～４の何れか１項に記載の端子ボックス。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、太陽光発電システムに好適な太陽電池モジュールの出力部を構成する端子ボックスに関する。

【０００２】

【従来の技術】近年普及している太陽光発電システムは、住宅等の屋根の上に配列設置される複数の太陽電池モジュールから構成され、図１７に示すように、所定個数の太陽電池モジュール１００、…をその裏面側出力部１１０を介して互いに直列接続し且つ当該直列接続の始端及び末端に位置する各太陽電池モジュールをそれぞれ屋内へ延びる引込みケーブル１４０、１４０に接続してなる直列一系統が多数連設されたものであり、屋内のインバータを通じて商用電力系統と連系し、屋内の電気配線に供給されるシステムが一般的である。

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【０００３】太陽電池モジュール１００としては、図１８に示すように、太陽電池１２０、該太陽電池を支持する支持台１３０、太陽電池１２０の裏面側に設けた出力部１１０を構成する端子ボックス１０１、及び該端子ボックスより延出する互いに極性の異なる二本の出力ケーブル１０６、１０６よりなるものがあり、各出力ケーブル１０６をそれぞれ前記支持台１３０の挿通溝１３０ａ及び図示しない隣側モジュールの挿通溝を介し軒側及び棟側に延出させることで、隣接する他のモジュールの出力部又は上記した引込みケーブル１４０に接続されている。

【０００４】これら太陽電池モジュールの出力部を構成する端子ボックス１０１は、特開平１１－０２６０３５号公報にも開示されているごとく、例えば図１９に示す内部構造を有している。

【０００５】すなわち、太陽電池裏面側に当接する底壁１５２の所定部位において当該太陽電池の裏面側に突設した出力取出用電極材を挿通するための挿通口１０５ａを備えた箱状の筐体１０５内部に、二個の中継端子１０４、１０４が左右対称で配置され、各中継端子１０４の基端側には筐体外部へ延出する上記出力ケーブル１０６が接続されている。各中継端子１０４、１０４の間にはバイパスダイオード１０２が接続され、太陽電池を構成する複数のセルの一部が影になっているときや夜間などに、該モジュールへ逆方向電流が流入することを未然に阻止するバイパス回路が構成されている。

【０００６】【発明が解決しようとする課題】ところで、中継端子１０４、１０４間に接続されるバイパスダイオード１０２は、従来から樹脂封止によりパッケージングされた汎用のダイオードが用いられており、中継端子１０４との具体的な接続形態は、該パッケージング内でダイオードの電極層にワイヤボンディングした導電性の細線と、これに連接して中継端子１０４に直接はんだ付されるリード線１２１を介して行われているが、住宅等の屋根上に設置される太陽電池モジュールの裏面側では、昼夜や季節等の変化による温度差が約＋４０℃～－９０℃と大きく、夏の昼間では８０℃を超える高温環境となるため、上記のような接続形態のバイパスダイオードでは、該ダイオードに発生した熱を細線及びリード線を通じて充分に放熱させることができず、特に高温環境下においては、期待されるダイオードの特性が確保されず、必要なバイパス機能が発揮されないばかりか、上昇した熱エネルギによりダイオードが断線若しくは破壊されるといった問題も有していた。

【０００７】本発明は係る現況に鑑みなされたものであり、バイパスダイオードの放熱性が担保され、高温環境下においても所定のダイオード容量が確保される端子ボ

ックスを提供せんとするものである。

【0008】

【課題を解決するための手段】本発明者は前述の課題を解決するにあたり鋭意検討を進めた結果、薄型ベアチップのバイパスダイオードを各導電性金属薄板の間に挟装することで、当該ベアチップと導電性金属薄板との間に充分な接触面積が維持され、ベアチップに生じた熱が導電性金属薄板を通じて速やかに放熱されること、及び前記導電性金属薄板の断面積及び前記接触面積を適宜設定することで、夏場等の高温環境下においてもベアチップに所定の必要電流量が通電可能となり、バイパス機能を確実に維持できることを見出し、本発明を完成するに至った。

【0009】すなわち本発明は、太陽電池の出力取出用電極材が挿通される挿通口を有した筐体の内部に、前記電極材が電気的に接続される接続部を備えた複数の中継端子、及びこれら中継端子間に接続される単又は複数のバイパスダイオードを配設した太陽電池モジュールの出力部を構成する端子ボックスであって、前記バイパスダイオードとして薄型ベアチップを用い、それぞれ中継端子に固着され且つ互いに対向して前記中継端子間に延出する二枚一組の導電性金属薄板の重合部に前記薄型ベアチップを挟装してなるバイパス回路構成体を備え、当該バイパス回路に所定の必要電流量が通電する際、少なくとも下記（A）～（C）：

（A）日光、瓦温度等の影響に基づくベアチップ周囲温度の変化

（B）通電による発熱に基づくベアチップの自己温度上昇

（C）上下電極層に接合している各導電性金属薄板を介した熱伝導に基づくベアチップの放熱温度降下

の各温度変化要素を総合したベアチップの表面温度が熱破壊温度以下となるように、各導電性金属薄板における断面積及び前記電極層に対する接合面積をそれぞれ設定してなる端子ボックスを提供する。

【0010】このような端子ボックスは、中継端子間に延出する導電性金属薄板の重合部に薄型ベアチップのバイパスダイオードを挟装した構成であるため、前記ベアチップに発生した熱は、上下電極層に接合している導電性金属薄板等を介した熱伝導により速やかに放熱されるとともに、上記（A）～（C）の各温度変化要素に基づいて導電性金属薄板の断面積及び接合面積が設定されているため、端子ボックス設置環境の急激な温度変化にも拘らず、前記導電性金属薄板を介した優れた放熱性が維持され、バイパス回路に必要電流量を通電するベアチップのバイパス機能が確実に維持される。

【0011】ここで、温度変化要素（B）と温度変化要素（C）を総合したバイパス回路通電時のベアチップの表面温度変化が、電流量1A当たり17℃以下の温度上昇である端子ボックスでは、夏場等の高温環境下においても充分なバイパス機能が維持される。

【0012】また、バイパスダイオードを配設した後、筐体内部にポッティング材が注入される端子ボックスであって、温度変化要素（C）に前記ポッティング材による熱伝導を考慮してなる端子ボックスでは、該ポッティング材を通じた放熱作用が加算されるため、温度変化要素（C）のベアチップの放熱温度降下が大きくなり、特にポッティング材として熱伝導性に優れたシリコン樹脂を用いれば、より効果的である。

【0013】さらに、前記導電性金属薄板として熱伝導率の大きい銅板を用いれば、温度変化要素（C）である当該導電性金属薄板を介したベアチップの放熱温度降下が大きくなる。

【0014】

【発明の実施の形態】次に本発明の実施形態を添付図面に基づき詳細に説明する。図1は、本発明における太陽電池モジュール出力部10の全体構成を示しており、図1～14は本発明に係る端子ボックスの代表的実施形態を示し、図中符号1は端子ボックス、2はベアチップ、3a、3bは導電性金属薄板をそれぞれ示している。

【0015】本発明に係る端子ボックス1は、図1及び図2に示すように、太陽電池の出力取出用電極材、例えば、太陽電池のプラス電極とマイナス電極にそれぞれ結線した二本のリード線が挿通される挿通口5aを有する筐体5の内部に、前記電極材がはんだ付等の接合手段によって電気的に接続される接続部41を備えた複数の中継端子4、4、並びに、これら中継端子4、4間に接続されるバイパスダイオードを配設した太陽電池モジュールの出力部10を構成する端子ボックス1であって、バイパスダイオードとして薄型ベアチップ2を用い、それぞれ中継端子4に固着され且つ互いに対向して中継端子4、4間に延出する二枚一組の導電性金属薄板3a、3bの重合部31に、前記ベアチップ2を挟装してなるバイパス回路構成体7を備えることで、ベアチップ2に発生した熱が、該ベアチップに対し広範囲な接触面積を有する導電性金属薄板3a、3bや中継端子4等を通じた熱伝導により速やかに放熱され、更に、図3の概略図に示す各導電性金属薄板3a、3bの断面積S_1及び前記電極層に対する接合面積S_2を以下に示すように設定することで、端子ボックス設置環境の急激な温度変化にも拘らず、前記導電性金属薄板3a、3bを介した優れた放熱性が維持され、バイパス回路に必要電流量を通電するベアチップ2のバイパス機能が確実に維持された端子ボックスである。

【0016】すなわち、本発明における導電性金属薄板3a（3b）の断面積S_1及び接合面積S_2は、バイパス回路構成体7で形成されるバイパス回路に所定の必要電流量が通電した場合に、少なくとも下記（A）～（C）：

（A）日光、瓦温度等の影響に基づくベアチップ周囲温

度の変化

（B）通電による発熱に基づくベアチップの自己温度上昇

（C）上下電極層に接合している各導電性金属薄板を介した熱伝導に基づくベアチップの放熱温度降下

の各温度変化要素を総合したベアチップ2の表面温度が、当該ベアチップ2の熱破壊温度以下となるように設定される。

【0017】温度変化要素（A）のベアチップ周囲温度は、太陽電池モジュールが稼動しており且つバイパス回路が非通電状態のときのベアチップ表面温度であり、上記日光及び気温度の影響以外に、気温や、筐体を含む端子ボックス各部の素材特性、構造、太陽電池モジュールの動作温度等に影響を受ける。

【0018】温度変化要素（B）の自己温度上昇は、太陽電池モジュールの容量等に応じて適宜選択される個々のベアチップの発熱特性に基づくものである。

【0019】温度変化要素（C）の放熱温度降下は、ベアチップ2の上下電極層に接合される各導電性金属薄板3a、3bを介した熱伝導に基づくものであり、導電性金属薄板3a、3bの熱伝導率、比熱、断面積S_1、接合面積S_2、長さL等により特定される。

【0020】そして、温度変化要素（B）と温度変化要素（C）を総合したバイパス回路通電時におけるベアチップ2の表面温度変化は、当該ベアチップ2の発熱量、前記導電性金属薄板3a、3bその他部材の熱伝導率、比熱等を用いた周知な熱伝導の微分方程式に基づく解析的方法や、差分法、有限要素法等の数値解法、その他の解法により予測することが可能であり、この表面温度変化が、電流量1A当たり17℃以下の温度上昇となるような上記断面積S_1、接合面積S_2を設定することで、夏場等の高温環境下においても充分なバイパス機能を維持する端子ボックスが構成されるのである。

【0021】以下に各部の構成を更に詳しく説明する。

【0022】中継端子4は、平面視略長方形状の長尺な金属製板状部材で構成されており、筐体底部の挿通口5aに臨む先端側43に余端はんだが上面に添着される接続部41を設け、且つ、他方の基端側44に芯線をカシメ止めすることで出力ケーブル6を接続した後、図4に示すように、筐体底壁52から上方に突設した取付け突起93及び位置決め突起94を、対応する取付け孔45、46にそれぞれ挿通した上、取付け突起93に圧着リング14を鉄着することで、当該中継端子4を底壁52に係止するとともに、出力ケーブル6、6は、筐体底部から当該出力ケーブルの延出方向に沿って突設されている固定基台56とこれに上方から嵌合する固定部材57との間に挟圧した上、前記固定基台56、固定部材57及び出力ケーブル6、6の外皮を互いに超音波溶着で筐体5と一体に固定することにより、前記中継端子4と共に筐体5内部に配設される。

【0023】尚、中継端子4と出力ケーブル6との接続手段は、前記カシメ止めした上から更にスポット溶接を施すことや、出力ケーブルを中継端子にネジ止めすることも好ましく、また、中継端子4を筐体5内部に配する手段は、前記圧着リング14の代わりに取付け突起93先端を超音波等で溶融して大径化することや、ネジ止めすることも好ましく、また、出力ケーブル6を筐体5に固定する手段は、該ケーブルを挟設した固定基台56及び固定部材57をネジ止めすることや、クランプにより直接筐体に固定することも好ましい。

【0024】出力ケーブル6、6の先端には、プラグ若しくはソケットを内装した防水コネクタ61、62が設けられており、これら出力ケーブル6、6は前記防水コネクタを介して隣接する太陽電池モジュールの出力ケーブル又は引込みケーブルに結線される。

【0025】薄型ベアチップ2のバイパスダイオードは、例えば、N型シリコンウエハの表面に拡散処理によりP型層を形成し、表面に格子状の凹溝をエッチング形成して、該凹溝に現出しているPN接合部にガラスパシベーションを施した後、該凹溝で囲設されたダイオード素子及びウエハ裏面に電極層を形成するとともに、該凹溝に沿って複数に分離して得られるメサ型ダイオードチップが用いられている。この薄型ベアチップのPN接合部における接合部温度は約150℃で、この接合部温度が当該ベアチップ2の熱破壊温度となる。したがって、バイパス回路構成体7の作製に際しては、各導電性金属薄板3a、3bの断面積及びベアチップ上下の電極層に対する接合面積を、上述の各温度変化要素（A）～（C）を総合したベアチップの表面温度が150℃以下となるように設定するのであり、本実施形態では、図5に示すように、周囲にガラスパシベーション層を被覆した薄型ベアチップ2の上下各電極層の略全面にわたって、無酸素銅からなる厚み約0.2mmの各導電性金属薄板3a、3bの一端側がそれぞれ接合され、二枚一組の導電性金属薄板3a、3b及び薄型ベアチップ2からなるバイパス回路構成体7が筐体外で迅速且つ確実に構成される。尚、各導電性金属薄板3a、3bは、銅以外に熱伝導性に優れたアルミニウムや、金、銀の単体又は合金が好適に使用できる。

【0026】各電極層の形状は、アノード電極側が2.45×2.45mm、カソード電極側が2.7×2.7mmの略正方形で、これら電極層に接合される各導電性金属薄板の接合部における幅は、アノード電極側の薄板3aが2.3mm、カソード電極側の薄板3bが4.0mmで、クリームハンダ等のろう接合金8を介し、それぞれ電極層の略全面を保持しており、アノード電極側の接合面積S_1が約5.6mm²、カソード電極側の接合面積が約17.3mm²にそれぞれ設定されている。

【0027】このように、導電性金属薄板3a、3bとその垂台部31に挟装した薄型ベアチップ2のバイパス

ダイオードとから構成されるバイパス回路構成体7は、上述の優れた放熱性以外に、樹脂封止されていない分、従来のバイパスダイオードに比べて薄内となり、筐体をよりコンパクト化できるといった効果を奏している。ただし、本発明はこのような構造に限定されるものではなく、重合部31の周囲を樹脂封止でパッケージングしておくことで、当該バイパス回路構成体の組み付け時の作業性や放熱性をさらに高め、且つ、後述の保護リブと同様、薄型ベアチップ2のバイパスダイオードに、はんだこて、工具その他の物体が直接当たり、熱ダメージや破損を与えることを未然に防止することも好ましい。

【0028】上記中継端子4、4を配設する際に、位置決め突起94が挿通される取付け孔46は、何れか一方の中継端子4の長手方向中央部に対して基端側44寄りに穿設されており、既にこれら中継端子4、4並びに出力ケーブル6が配設された筐体5内に、バイパス回路構成体7を組み付ける際には、図6に示す如く、前記取付け孔46を貫通して中継端子4上方へ突出した位置決め突起94を、一方の導電性金属薄板3bに穿設される位置決め孔34に係合することで、中継端子4、4の上面間に位置決めされた状態で容易且つ迅速に橋渡され、且つ各導電性金属薄板3a、3bを中継端子4の上面にはんだ付けで固着することで、当該バイパス回路構成体7の橋渡し方向を誤ることなく、中継端子4、4の各基端寄りに接合される。

【0029】バイパス回路構成体7における導電性金属薄板3a、3bの側縁部には、筐体5の底壁52から当該導電性金属薄板3よりも上方に起立する複数対のリブ9、…が当該側縁部に沿って付設されており、詳しくは、図2に示したように、各導電性金属薄板3a、3bの端側71a、71b両側縁に沿って付設した二対の規制リブ91a、91b、並びに、ベアチップ2が搭載されている重合部31両側縁に沿って付設した一対の保護リブ92が、それぞれ付設されている。

【0030】ここで、規制リブ91a、91bは、バイパス回路構成体7を中継端子4、4の上面間に橋渡しする際、当該リブ間に導電性金属薄板3の端側71a、71bをそれぞれ挟入することで、該導電性金属薄板3の位置決め手段として機能し、当該バイパス回路構成体7の組み付け作業を容易且つ迅速にするものであり、さらに詳しくは、一方の導電性金属薄板における重合部を構成しない端側71aに、中継端子4の外側に延出する幅狭部35を予め形成しておき、該幅狭部35をこれに対応する規制リブ91aの間に挟入することで、橋渡し方向を誤ることなく組み付けできる。

【0031】また、保護リブ92は、同じくバイパス回路構成体7を中継端子4、4の上面間に橋渡しする際、当該リブ間に重合部31を挟入することで、橋渡したバイパス回路構成体7と中継端子4との接合、または後述の出力取出用電極材と中継端子4との接合に用いるはんだこて等の加熱手段が重合部31に直接接触することや、当該バイパス回路構成体7を筐体内に組み込んだボックス本体11を移送する際、工具その他の物体が重合部31に直接衝撃を与えることなどを回避し、バイパスダイオードの熱ダメージや衝撃による破損を未然に防止するものである。

【0032】尚、筐体内には、規制リブ91a、91b及び保護リブ92以外に、他のリブを設けても良いが、これらリブは、前記バイパス回路構成体その他の部材と筐体底壁との間などにポッティング材が難なくスムーズに充填されるよう、導電性金属薄板3a、3bの延出方向、すなわち規制リブ91a、91b又は保護リブ92に対して平行に設けておくことが好ましい。

【0033】筐体5の内部に設けるバイパスダイオードの個数は、太陽電池モジュールの容量等に応じて適宜決定され、例えば二つのバイパスダイオードを中継端子4、4間に並列接続するときには、図7に示すように、当該中継端子4、4の上面間に上記したバイパス回路構成体7を二本横並びで平行に橋渡し且つ接合すれば良い。このように複数のバイパス回路構成体7を並列接続すれば、通電時の電流量が分散され、上述した温度変化要素（B）のベアチップの発熱による自己温度上昇を抑えることが可能となる。

【0034】また、バイパス回路構成体7を構成している各導電性金属薄板3a、3bは、扁平な板状体で且つ長手方向に略真直な形状を有しているが、昼夜等の温度変化に起因する熱影響により前記導電性金属薄板が伸縮を繰り返し、その重合部31に挟装した薄型ベアチップ2のバイパスダイオードに大きな判断力が生じる可能性があるため、特に中継端子4、4間の離間距離が大きく、各導電性金属薄板3の延出寸法が大きくなる場合には、図8の（a）、（b）に例示するように、該導電性金属薄板3a、3bの延出方向に沿った全体又は一部に、湾曲した部位32又は屈曲した部位33を設けたものも好ましい。

【0035】本実施形態に係る端子ボックス1は、筐体5の上端開口部53に嵌装される蓋体51を備えており、上記の如く、中継端子4、4の上面間にバイパス回路構成体7を橋渡し且つ接合してなるボックス本体11は、挿通口5aを介して出力取出用電極材を筐体内部に挿通した状態で、ネジや接着剤、粘着剤等により太陽電池裏面側に固定され、前記電極材を中継端子4の接続部41に接続した後、図9に示すように、これら電極材12、バイパス回路構成体7、及び中継端子4、4が収装され且つ隔壁54で囲繞された筐体内の所定空間55に、エポキシ樹脂やポリウレタン、シリコン樹脂等からなるポッティング材13を注入、充填することで、各部材及びその接続部分を気密に封止した上、前記蓋体51により上端開口部53を閉塞して端子ボックス1の組み立てが完了される。

【００３６】前記ポッティング材１３は、筐体５の内部に配する各部材及び接続部分を気密に封止することで、湿気や雨水、埃等の侵入を防ぎ、その腐食や劣化、衝撃による破損を防止しつつ絶縁性を維持するものであり、前記ポッティング材として特に熱伝導性に優れたものを採用すれば、重合部３１の上下に充填される当該ポッティング材を通じて、ベアチップ２の放熱性をより高めることができる。

【００３７】そして、このような端子ボックス１においては、図１０に示すように、ベアチップ２で発熱した熱が、ベアチップ２の上下電極層に熱接触している導電性金属薄板３ａ、３ｂ、各薄板３ａ（３ｂ）に熱接触している中継端子４とポッティング材１３、及びこれに熱接触している出力ケーブルや筐体５を伝熱部材とした熱流路を仮定することで、上述した温度変化要素（Ｂ）と温度変化要素（Ｃ）を総合してなるバイパス回路通電時のベアチップ表面温度が予測できるのである。

【００３８】尚、上記ポッティング材１３は必ずしも必要ではなく、この場合には図１１に示すように、ベアチップ２で発熱した熱が、ベアチップ２の上下電極層に熱接触している導電性金属薄板３ａ、３ｂ、各薄板３ａ（３ｂ）に熱接触している中継端子４及び各中継端子４に熱接触している出力ケーブルや筐体５を伝熱部材とした熱流路を仮定することで、同じくベアチップ表面温度が予測できる。

【００３９】また、中継端子間に延出した二枚一組の導電性金属薄板３、３及びその重合部３１に挟装された薄型ベアチップ２のバイパスダイオードからなるバイパス回路構成体７は、筐体底壁５２より上方に浮いた状態に設けられているが、本発明はこのように下方に空間を設けた構造に限定されるものではなく、図１２に示すように、薄型ベアチップ２を挟装している重合部３１の下面を筐体底壁５２に密着させ、該底壁５２を通じて放熱性の向上を図るものも好ましい。この場合、導電性金属薄板３ａから筐体底壁５２への熱流路が追加され、ベアチップの放熱効果が向上する。

【００４０】端子ボックスの他の例として、例えば図１３及び図１４に示すように、前記中継端子４に出力取出用電極材１２を接続する接続部４１、導電性金属薄板３を固着する固着部及びその近傍部を除いた当該中継端子４全体と、該中継端子４の基端側に接続され、筐体５外部に延出する出力ケーブル６とを、筐体５と一体的に成形してなる端子ボックス１’も好ましく、筐体底壁５３にはポッティング材の充填により気密に封止すべき接続部４１及び固着部を囲繞する隔壁５４’が立設されている。

【００４１】このような端子ボックス１’のボックス本体１１は、筐体５を成形する際に、中継端子４とこの基端側に既に接続した出力ケーブル６とを金型内にインサートして、当該筐体５と一体的に射出成形して作製され、上述の端子ボックス１において必要な中継端子４及び出力ケーブル６を筐体に固定するための取付け突起９３や取付け孔４５、圧着リング１４、固定部材５７等が不要となり、部品点数が少なく組立工程が簡略化されるとともに製造コストが大幅に低減される。また、隔壁５４’で囲繞される空間は、上述の端子ボックス１の隔壁５４で囲繞される空間５５に比べ、中継端子基端側４４における出力ケーブル６との接続部分を含まない分だけ小さくなり、充填するポッティング材の使用量も低減されるのである。

【００４２】

【実施例】次に、本発明に係る端子ボックスと従来の端子ボックスとを比較する。

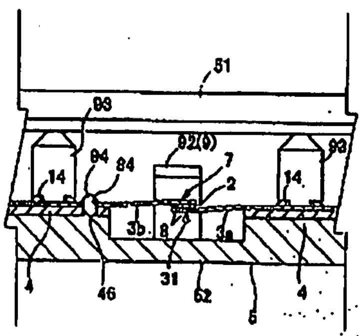
【００４３】実施例１は上記代表的実施形態に示すように、メサ型ベアチップPTD27K（パワード有限会社製）の上下電極層の略全面に厚さ０．２ｍｍの銅板３ａ．３ｂをそれぞれ接合したバイパス回路構成体７を備え、内部にポッティング材としてシリコン樹脂を封入した端子ボックス１、実施例２は、同じくバイパス回路構成体７を備え、内部にポッティング材を封入しない端子ボックス１、比較例１と比較例２は、それぞれ１０Ａ、２０Ａ用のバイパスダイオードFSF10A60、FSKF20A（何れも日本インター株式会社製）を用いた図１９に示す従来からの端子ボックス１０１である。

【００４４】図１５は、実施例１及び実施例２の各端子ボックスにおいて、ベアチップに通電される電流量と、そのときにベアチップの表面で実測される上昇温度との関係を示すグラフであり、上述の温度変化要素（Ｂ）及び（Ｃ）を総合したベアチップ表面温度変化の実測値に基づいている。図１６は、上記実施例１、実施例２、比較例１、比較例２の各端子ボックスにおいて、周囲温度と該周囲温度で通電可能な電流量との関係を示すグラフである。

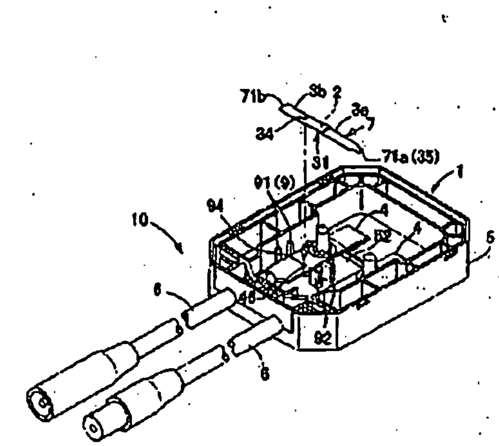
【００４５】図１５のグラフから分かるように、本発明に係る実施例１の端子ボックス１は電流量１Ａ当たり約１１℃の温度上昇、実施例２の端子ボックス１は電流量１Ａ当たり約１４℃の温度上昇で、何れも上昇温度１７℃以下を満たしている。また、端子ボックス内部にシリコン樹脂を封入した実施例１が、封入していない実施例２に比べて温度上昇が抑制されており、シリコン樹脂の封入でベアチップの放熱が促進されることが分かる。

【００４６】そして、図１６のグラフによれば、周囲温度が８０～９０℃以上となる夏場等においては、比較例１のバイパスダイオードに流れる電流量が約１．０７Ａ以下、比較例２のバイパスダイオードに流れる電流量が約１．３７Ａ以下となり、充分なバイパス機能が維持されないのに対し、実施例１のベアチップでは、周囲温度が約１０７℃で電流量４Ａ、実施例２のベアチップでは、周囲温度９４℃で電流量４Ａが確保され、周囲温度９０℃以上となる高温環境下においても充分なバイパス

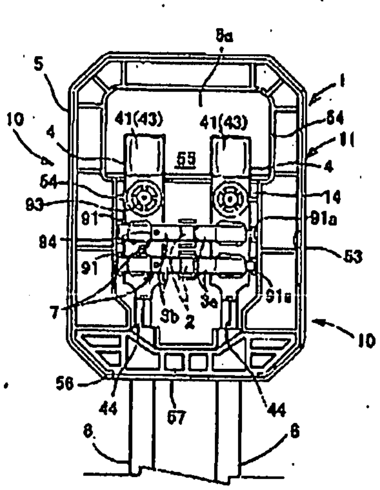
【図5】



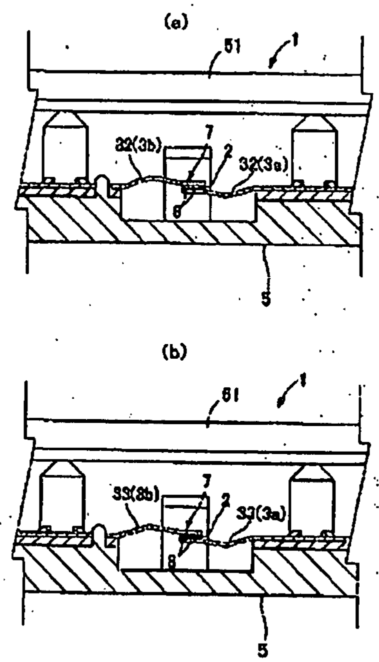
【図6】



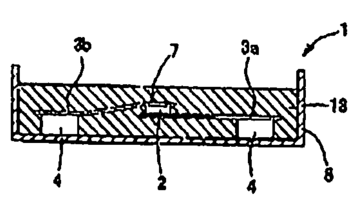
【図7】



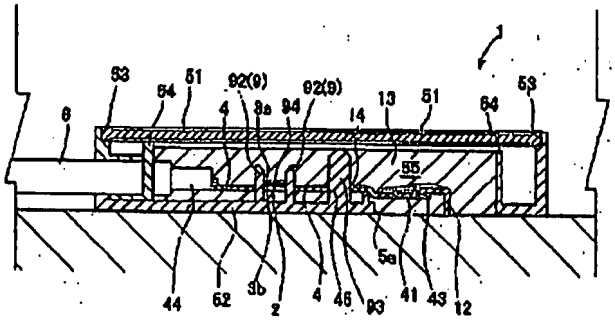
【図8】



【図10】



【図9】



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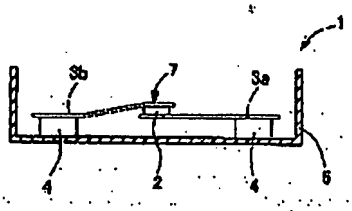

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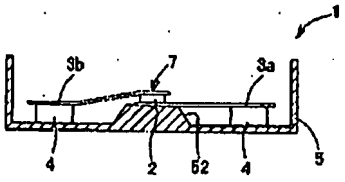

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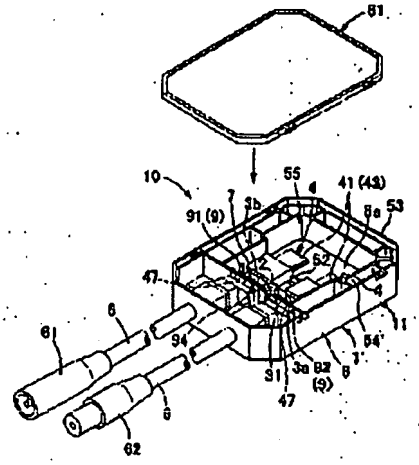

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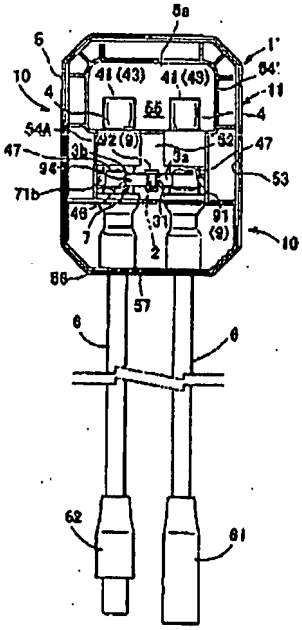

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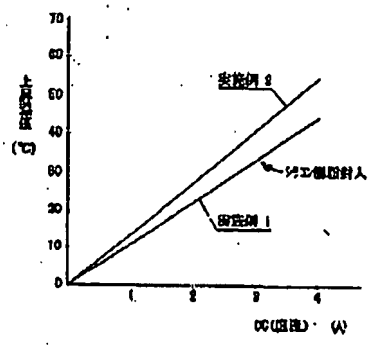

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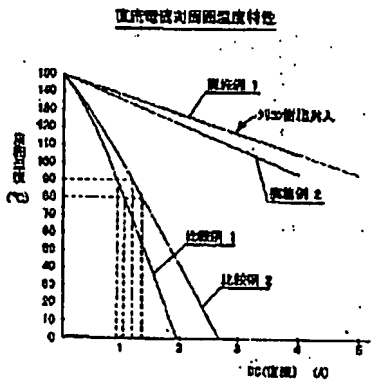

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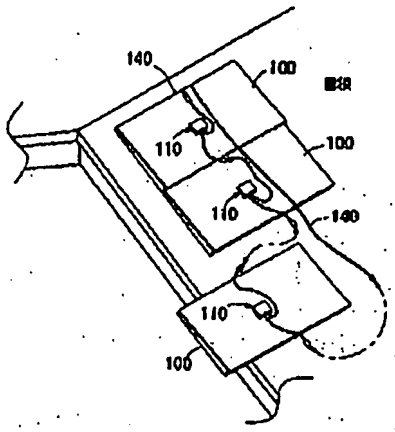

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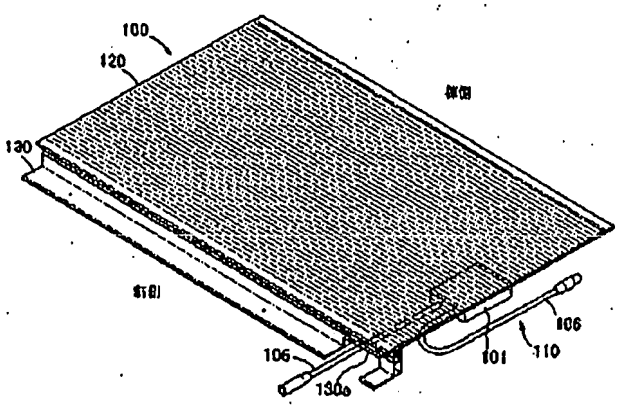

【図19】